FREQUENCY DEPENDENT TELECOMMUNICATION HYBRID CIRCUIT

The present invention relates to a telecommunication hybrid circuit adapted to interface a line driver and a telecommunication line, said telecommunication hybrid circuit having first and second driver terminals connected to said line driver and first and second telecommunication terminals connected to said telecommunication line, said telecommunication hybrid circuit further comprising:

- a first series impedance connected between said first driver terminal and said first telecommunication terminal;
- a second series impedance connected between said second driver terminal and said second telecommunication terminal;
- a first cross-coupled impedance connected between said first driver terminal and said second telecommunication terminal; and
- a second cross-coupled impedance connected between said second driver terminal and said first telecommunication terminal.

Such a telecommunication hybrid circuit with series impedances is generally known in the art. A problem is that the power consumption thereof is relatively high.

A first solution to reduce the power consumption of the known hybrid circuit consists in increasing the value of the series impedances. This first solution reduces the power consumption but leads to a reduction of the bit rate of the receive signal. Such a reduction of bit rate is to avoid, especially when the telecommunication hybrid circuit is used as an interface between a telecommunication line and the line driver of an Asymmetric Digital Subscriber Line [ADSL] Central Office equipment.

An object of the present invention is to provide a telecommunication hybrid circuit of the above known type but with reduced power consumption, while not negatively affecting the bit rate of the receive signal.

According to the invention, this object is achieved due to the fact that each of said first and second series impedances includes a device having a frequency dependant impedance.

In this way, the values of the series impedances can be adapted to the telecommunication hybrid circuit requirements as mentioned above.

Another characterizing embodiment of the present invention is that said telecommunication hybrid circuit is adapted to receive signals from and to transmit signals to said telecommunication line, that the frequencies of the received signals are in a receive frequency band and the frequencies of the transmitted signals are in a transmit frequency band, said transmit frequency band being distinct from said receive frequency band, and that the frequency dependant device has first impedance values for the frequencies of said receive frequency band and has second impedance values for the frequencies said transmit frequency band, said second impedance values being different from said first impedance values.

Because the series impedances have a different value for the receive and for the transmit frequency bands, the bit rate reduction is controlled accordingly. In other words, the telecommunication hybrid circuit behaves as a frequency band filter showing a different impedance in function of the frequency. Different impedances can be obtained in function of the frequency band.

In a preferred embodiment, the present invention is characterized in that said first impedance values for the frequencies of said receive frequency band are relatively high, while said second impedance values for the frequencies said transmit frequency band are relatively low.

A lower series impedance leads to less power consumption in the transmit frequency band, whilst a higher series impedance allows to maintain a suitable bit rate in the receive frequency band.

Also another characterizing embodiment of the present invention is that said first series impedance comprises a first frequency

dependant device connected in series with a first resistor, while said second series impedance comprises a second frequency dependant device connected in series with a second resistor.

Further characterizing embodiments of the present frequency dependent telecommunication hybrid circuit are mentioned in the appended claims.

It is to be noticed that the term 'comprising', used in the claims, should not be interpreted as being restricted to the means listed thereafter. Thus, the scope of the expression 'a device comprising means A and B' should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

Similarly, it is to be noticed that the term 'coupled', also used in the claims, should not be interpreted as being restricted to direct connections only. Thus, the scope of the expression 'a device A coupled to a device B' should not be limited to devices or systems wherein an output of device A is directly connected to an input of device B. It means that there exists a path between an output of A and an input of B which may be a path including other devices or means.

The above and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings wherein the figure represents a frequency dependent telecommunication hybrid circuit according to the invention.

The hybrid circuit shown in the figure is adapted to interface terminals LD1, LD2 of a line driver in a telecommunication system with terminals TL1, TL2 of a telecommunication line.

Between a first line drive terminal LD1 and a first telecommunication terminal TL1, the hybrid circuit comprises the series connection of a first resistor R1 and a first frequency dependant device Z1, while between a second line drive terminal LD2 and a

second telecommunication terminal TL2, the hybrid circuit comprises the series connection of a second resistor R2 and a second frequency dependant device Z2. Additionally, the hybrid circuit comprises, between the first line drive terminal LD1 and the second telecommunication terminal TL2, a first cross-connected impedance constituted by the series connection of two resistors R3 and R4 at the junction point of which a first receive terminal Rx- of a receive circuit (not shown) is provided. Similarly, a second receive terminal Rx+ of the receive circuit is provided at the junction point of resistors R5 and R6 that are series connected between the second line drive terminal LD2 and the first telecommunication terminal TL1, forming together a second cross-connected impedance. It is to be noted that the resistors R3 and R5, as well as the resistors R4 and R6 are respectively substantially identical. Similarly, the resistors R1 and R2, as well as the frequency dependant devices Z1 and Z2 are also respectively substantially identical.

The devices Z1 and Z2 have a frequency dependant impedance and the present telecommunication hybrid circuit is preferably used to operate according to the Asymmetric Digital Subscriber Line [ADSL] protocol. Therein, signals are received from the telecommunication line in a receive frequency band of which the frequencies are relatively low, while signals are transmitted to this telecommunication line in a transmit frequency band of which the frequencies are relatively higher.

The frequency dependant impedances of each device Z1 and Z2 are such that these devices show relatively low impedance values (near to 0) for frequencies of the transmit frequency band and relatively high impedance values for the frequencies of the receive frequency band. As a result, the power consumption is reduced in the transmit direction where the series impedances are relatively low.

However, the values of the series impedances remain relatively high in the receive direction in order to avoid bit rate reduction.

A final remark is that embodiments of the present invention are described above in terms of functional blocks. From the functional description of these blocks, given above, it will be apparent for a person skilled in the art of designing electronic devices how embodiments of these blocks can be manufactured with well-known electronic components. A detailed architecture of the contents of the functional blocks hence is not given.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention, as defined in the appended claims.